Spectrogram

Allows to visualize spectral variations of speech or voice according to time under a spectrographic representation.

Principle

The Spectrogram (or sonogram) allows to visualize the spectral variations of the speech signal versus time. The spectral analysis is realized with FFTs in wide or narrow bands. It is possible to choose at any instant of the Spectrogram the representation of spectral sections (frequency / amplitude) or to perform measures of signal versus noise ratio.

Preparation

Equipment

Patient is standing up in front of the on-stand microphone.

Turn the selector **INPUT 1-LEFT** on **MICRO**.

Software

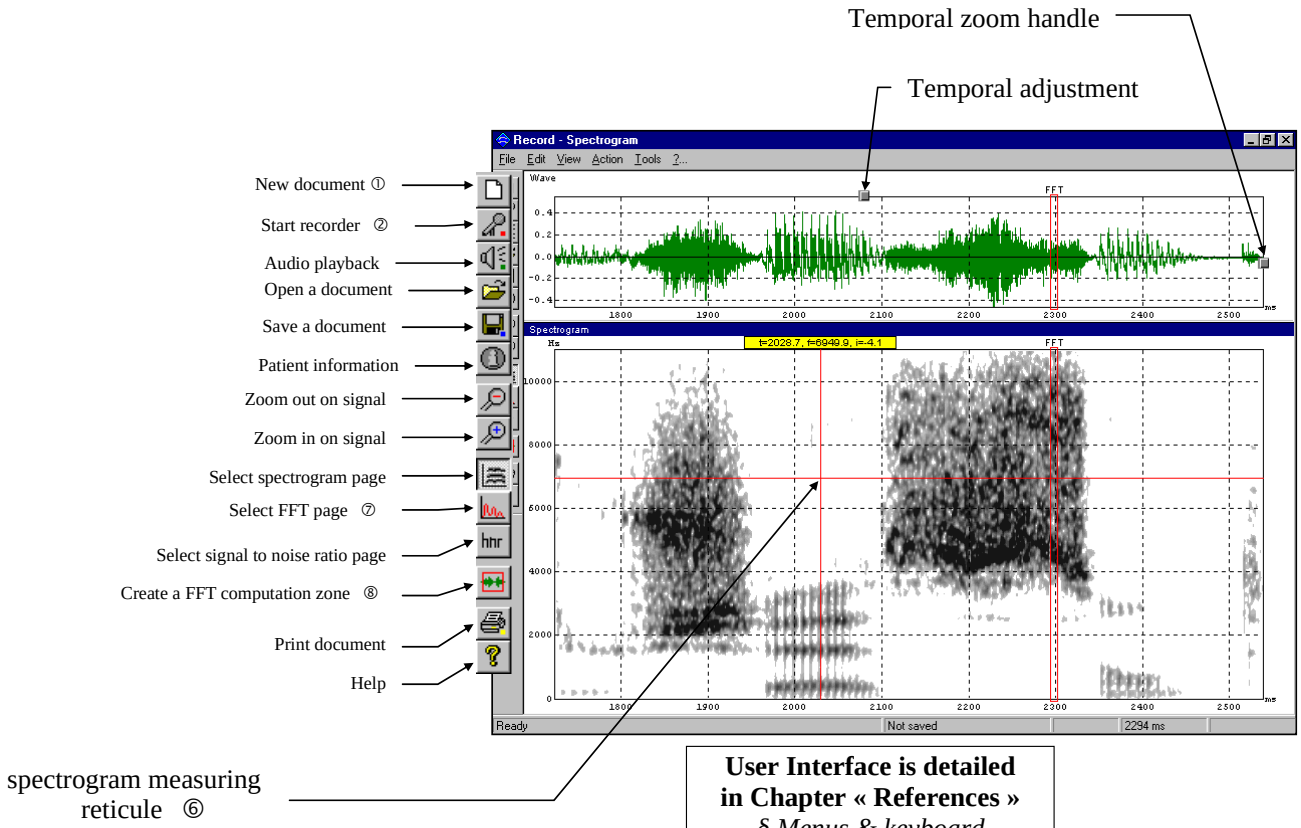
Launch the SESANE software by clicking this icon in Windows task bar.

In SESANE, enter the patient information :

Then, click twice on this icon : 

Using Spectrogram

Main window



User Interface is detailed in Chapter « References »
§ Menus & keyboard
§ Signal Manipulation

Protocol

① Create a new document if necessary

② Start real time display.

The recording control window appears.

Patient makes a try.

③Verify the recording level of the acoustic input vu-meter. Beware of not reaching +3 dB while recording. If necessary, adjust the volume button of INPUT 1-LEFT. A low signal may indicate a bad position of the selector MASK - MICRO - LINE.

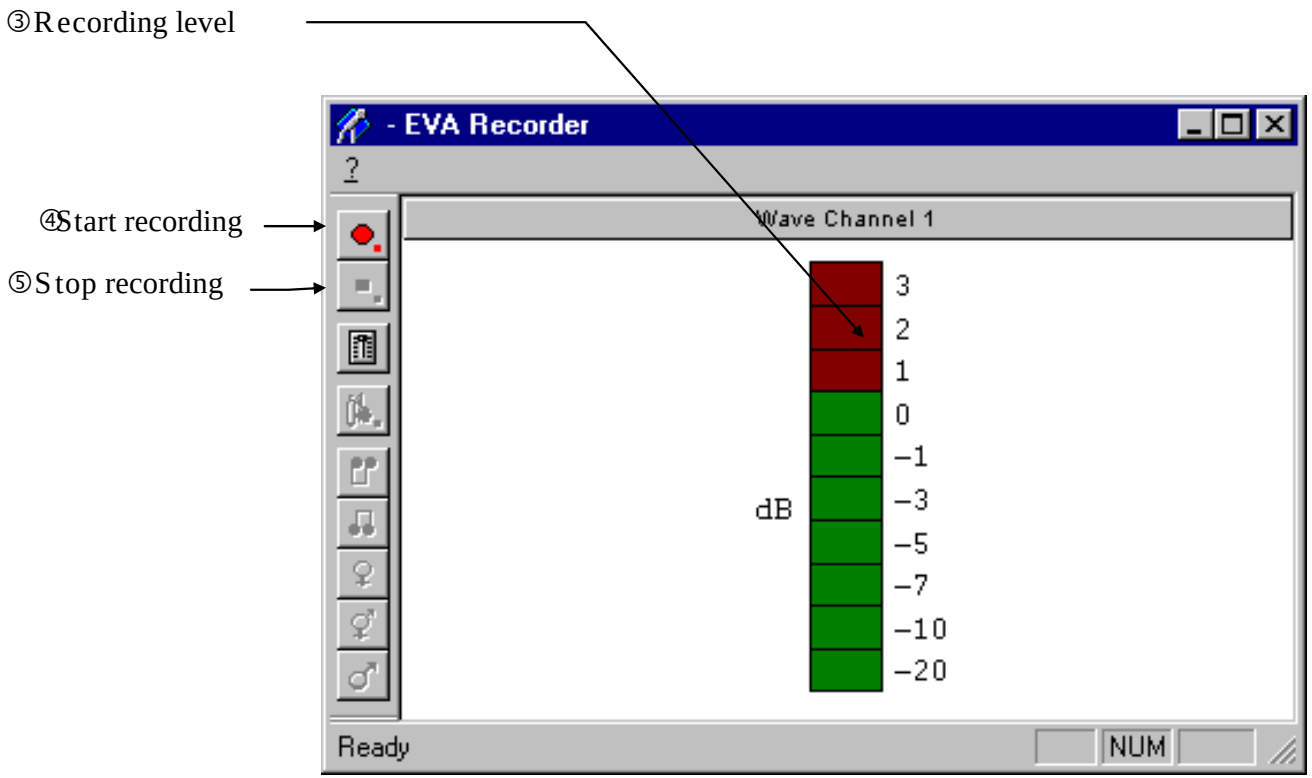
④ Start recording.

The patient produces its sentence.

⑤ Stop recording.

The main window appears again..

Recording control window



Depending on the needs :

⑥ Take measures on Phonetogram by clicking the left mouse button. A measure reticule appears, displaying the pointed values in ms, Hz, and dB.

Or :

⑦ Display the FFT page and

⑧ Create a FFT computation zone. This one can be moved along the speech signal.

Save the document.

Print..

Measurement

Spectrogram page

The spectrogram settings can be changed by calling its properties (right mouse button).

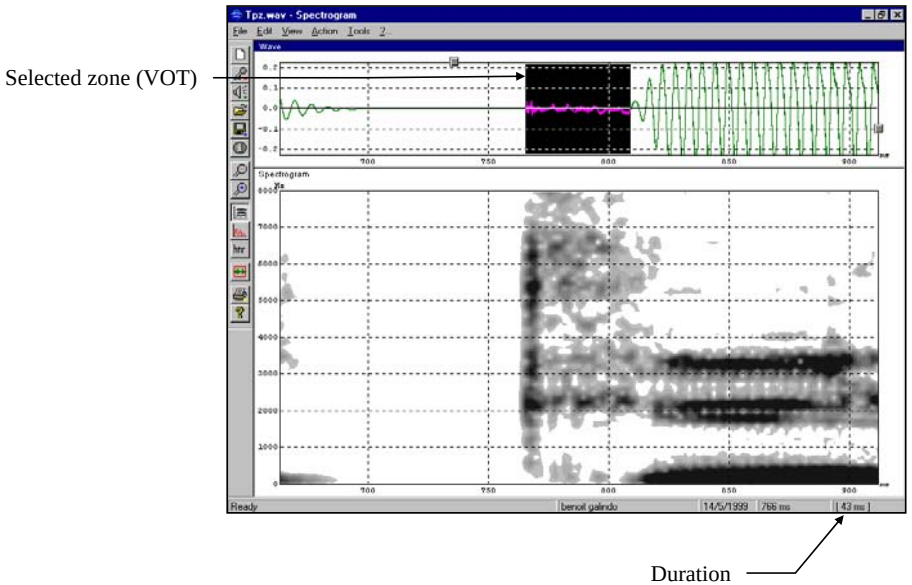
In a general point of view, you can take measures on Spectrogram by clicking the left mouse button. A measure reticule appears, displaying the pointed values in ms, Hz, and dB ⑥.

The spectrogram is a tool made for measuring duration of phonetic segments (ex : formants transition, phoneme duration, Voice Onset Time...). In such a case, it is better to use a wide band spectrogram.

To measure duration, select a zone using wave signal and spectrogram. The duration selected is displayed directly in the status bar. To select a zone :

1. place the mouse pointer at the beginning,
2. press and hold down the Shift key + left mouse button,
3. move the mouse until the end
4. release

ex : Voice Onset Time (VOT) measurement



FFT page

The FFT page displays the wave spectrum around a frame called computation zone ⑧.

To move this zone :

1. place the mouse pointer near the left side of the zone
2. press and hold down the left mouse button,
3. move the mouse
4. release

To change the zone duration, call spectrum properties (right mouse button).

To take measures on the spectrum :

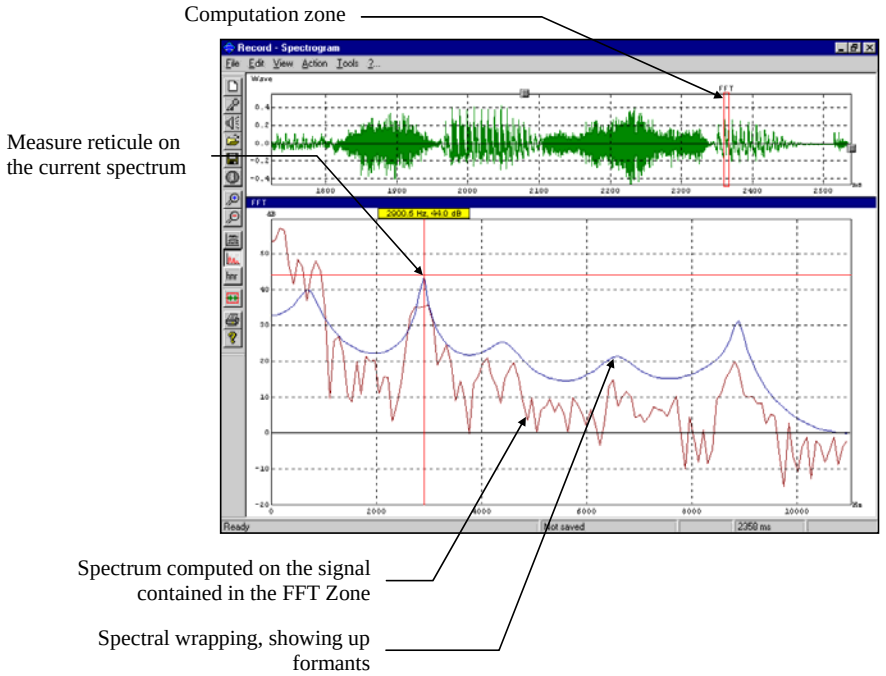
1. place the mouse pointer on the spectrum
2. click the left mouse button.
3. a reticule appears, displaying the pointed values in Hz, and dB.

To measure formants position :

1. Set the spectrum in wide band (cf. Properties)
2. Use the LPC spectrum which displays spectral peaks
3. Maybe you should erase F0 effect by checking the pre-emphasis option (cf. Properties)

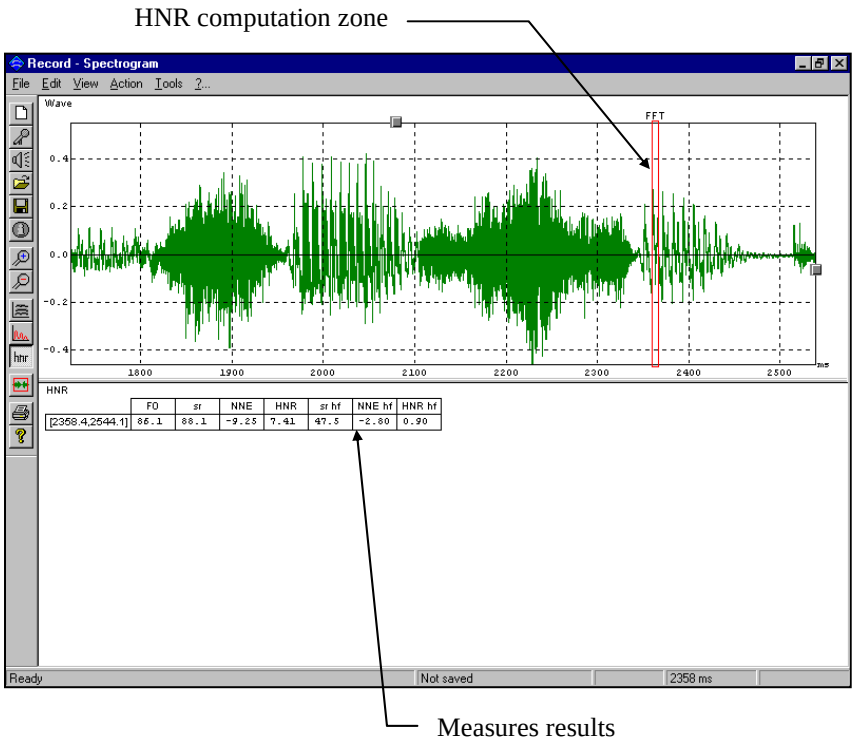
To display harmonic structure :

1. Set the spectrum in narrow band (cf. Properties)
2. Use the FFT spectrum which displays F0 and harmonics
3. Maybe you should rise spectral resolution if necessary (cf. Properties)



HNR page

The HNR page displays the harmonic to noise ratio around a frame called computation zone ⑧.



To move this zone :

1. place the mouse pointer near the left side of the zone
2. press and hold down the left mouse button,
3. move the mouse
4. release

To change the zone duration, call spectrum properties (right mouse button).

Generally, this frame must be long enough to provide sufficient information on F0 and short enough to avoid an analysis of a non stable wave (typically : 250 ms)

This analysis is performed with spectral methods. We consider that the speech signal is made up of two components :

- a periodic component (F0 & harmonics)
- a noise component (the rest)

the mathematical sum of theses two components is considered as the full signal.

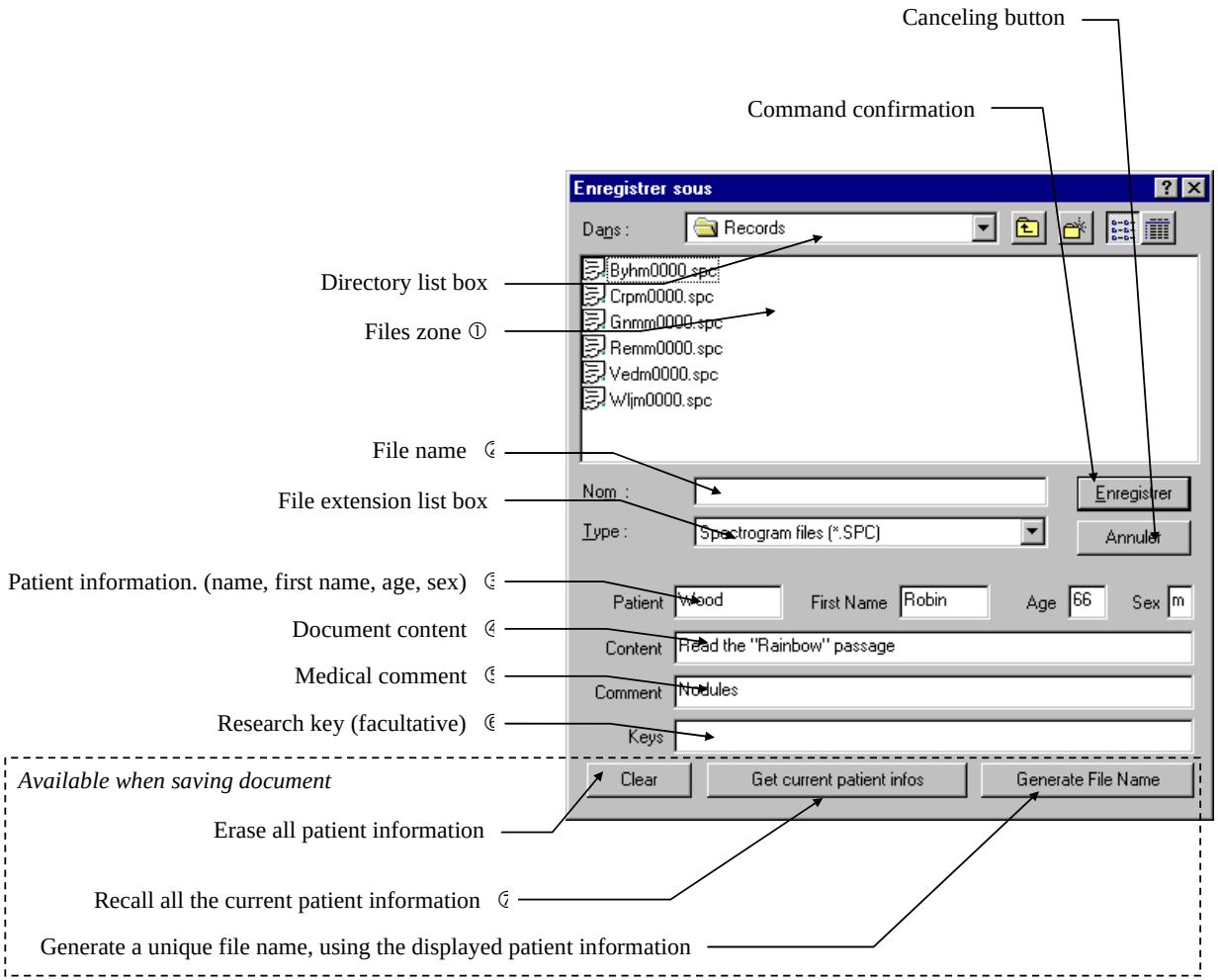
The measures are given under redundant forms :

SR	*(%)*	Relative Signal Intensity = Energy (*F0* + *Hi*) / Total energy
H/N	(no unit)	Harmonic-to-noise Ratio = Energy(*F0* + *Hi*) / Energy(noise)
NNE	(dB)	Normalized Noise Energy = 10. Log [Energy(noise) / Total Energy]

The first values (SR, H/N, NNE) are computed on the whole spectrum.
The second values (SR hf, H/N hf, NNE hf) are computed one the spectrum part above 1 kHz.

Rem : this method is different than the one used in the Voice Profile Application

Data Management



Save a document

Method 1 : Click on ⑦. *The current patient information appear in the fields ③, ④, ⑤, ⑥. A unique filename is automatically generated in ②.* Confirm by clicking on ⑨.

Method 2 : Enter manually the patient information in the fields ③, ④, ⑤, ⑥. Click on ⑧. *A unique filename appears in ②.* Confirm the saving by clicking on ⑨.

Method 3 : Enter manually the patient information in the fields ③, ④, ⑤, ⑥. Enter a file name in ①. Confirm the saving by clicking on ⑨.

Open a document

Select a document in ① by a single click with the left mouse button.. *The file name appears in ② with its information as well in ③, ④, ⑤ ⑥.* Confirm your choice by clicking on ⑨.

To obtain information about the current document

Options

By clicking on the spectrogram with the right mouse button, a contextual menu appears.

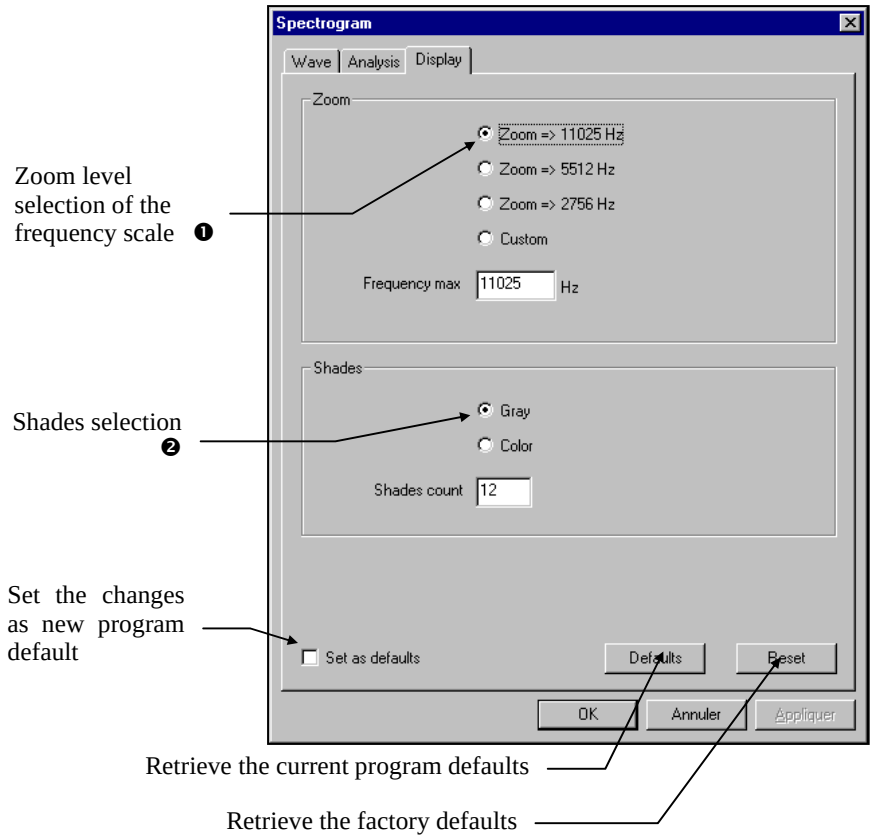
Choose the « properties » option.

You can also modify the program parameters by selecting the menu « Tools | Options » or by typing the « O » key.

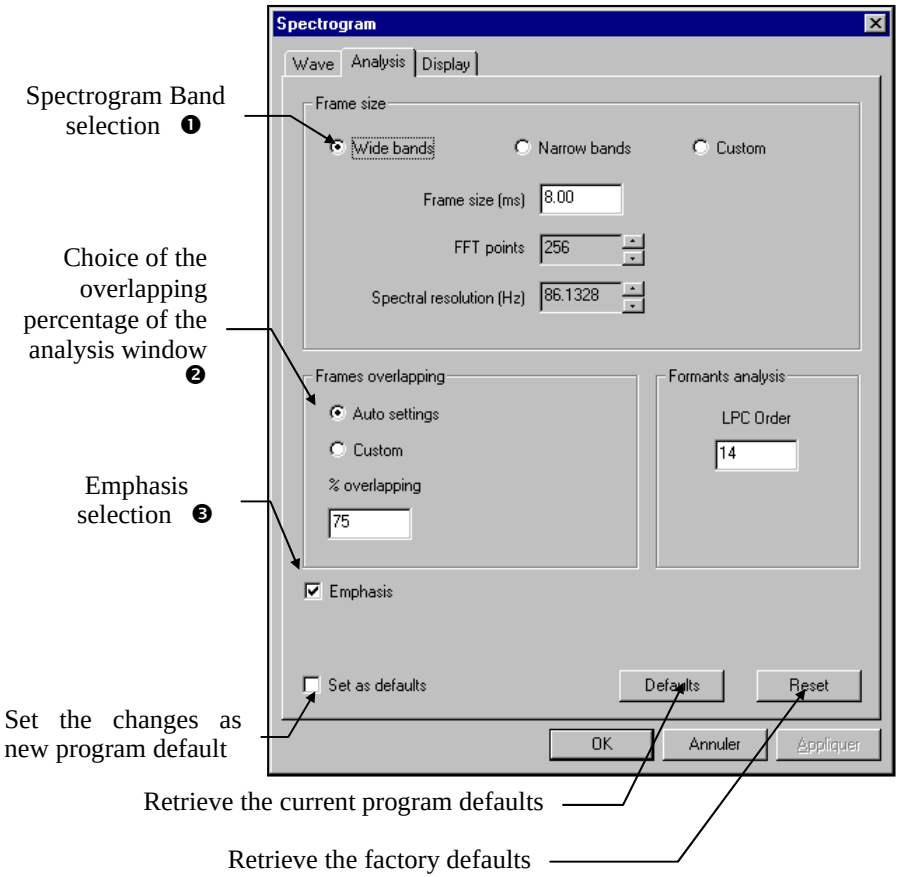
Setting the display

❶ The « zoom » option allows to select the displaying of a part of the spectrum. This option is useful to observe the formants generally localised in the low part of the spectrum.

❷ « shades » allows to choose between a grey or colour display



Analysis settings



❶ You can select a Wide Band spectrum, a Narrow Band one or you can fix your own parameters. It is useful to know that the Narrow Band analysis uses long windows. So, it gives you a poor temporal precision but a great quality for frequency measure (ex : harmonics). On the other hand, Wide Band analysis uses short windows. So, it gives you a good temporal precision but a medium quality for frequency measure (ex : formants).

For a FFT spectrum, the most important parameter is the length of the analysis window. You can set this length by writing the value in the " Window Size (ms) " text edit. The value must be in milliseconds (1 second = 1000 ms). Do not forget that the longer the window is, the more the frequency analysis is precise. In the other hand, the shorter the window is, the more the temporal analysis is precise.

❷ A spectrogram is built using successive spectra. Each spectrum is computed on a signal window. This window is shifted along the signal. This operation is called « window step ». You can let the algorithm fix automatically this parameter. If you want a precise value, just set the overlapping percent in the text edit. Window step is equal to : *step(ms) = window size(ms) * (1 - percent/100)*

❸ Generally, spectral distribution of a speech signal has a 6 or 12 dB/Oct slope. That means that acute frequencies are lower than bass. The consequence is that you cannot see them on a spectrogram. Ticking « High-Frequencies emphasis » allows to roll up the acute. This option does not change the values that you can read with reticule.